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Virgin Islands

EFFECTS OF DREDGING AT GREAT CRUZ BAY, ST. JOHN

Robert P. vanEepoel David I. Grigg

June 1970

WATER POLLUTION REPORT # 5

GOVERNMENT OF THE VIRGIN ISLANDS

DEPARTMENT OF HEALTH, DIVISION OF ENVIRONMENTAL HEALTH

WATER POLLUTION REPORT

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I. INTRODUCTION

This report presents data, conclusions and recommendations which result from preliminary investigations of the disturbances produced by dredging activity in Great Cruz Bay, St. John. The observations and measurements were made by staff members of the Caribbean Research Institute, namely, David I. Grigg, water-chemist/marine biologist and Robert P. vanEepoel, Project Director. They were assisted by Frank L. Mills, Summer Research Assistant, who did ground level photography, and by C.R.I. laboratory aids, who assisted in the analytical procedures. Most of the data derives from reconnaissance on 26th May 1970, some from continuing observations at the site from August 1969 to the present, and some from the personal observations and experiences of Dr. A. E. Dammann,Director of VIERS. Dr. Dammann lives at Chocolate Hole, St. John. He makes trips past Great Cruz Bay daily and has made frequent scientific observations in the waters at the Western end of St. John. Thanks are due him for his consultations and comments.

II. SITE DESCRIPTION

Great Cruz Bay is one of several arms of Pillsbury Sound,which separates St. Thomas and St. John. The sound connects the Atlantic Ocean to the Caribbean Sea, and has generally a north-south orientation. Of the bays at the Western shoreline of St. John, Great Cruz Bay is the largest, is roughly rectangular in shape, and covers an area of about 3.5 million square feet. The opening is oriented to a direction of about 060 degrees (30 degrees North of East) and the bay has a width of about 1300 feet and a length of about 2400 feet. The eastern shoreline formerly was sand covered, but of recent years has been mostly rock rubble. Behind the beach is a low swampy area which occasionally was covered by run-off of heavy rains or, rarely, with salt water from storm seas cresting over the berm. It was a habitat for one of the largest colonies of landcrabs on the island. The north shore is rocky and precipitous, as is the western half of the south shore. The remainder of the shoreline is gravel and rubble.

III. WATER QUALITY OBSERVATIONS

On May 26, extensive sample and data collection was made in Great Cruz Bay. Twenty one stations were occupied at approximately 400 feet intervals. At each station the temperature, depth, pH, dissolved oxygen, water color, Secchi depth, and surface and submarine light levels were measured. In addition, a water sample was taken for salinity and suspended solids analysis. The data are presented in tabular and graphic form and discussed in the following sections.

Physical Data

Surface temperatures in the bay increased from that of relatively cool (27.5 °C) water from Pillsbury Sound to slightly warmer (28.4 °C maximum) water at the head by the bay. Also the south shore water is slightly warmer than the rest. This distribution is doubtless due to solar heating of the shallower water along the east and south shores and in the latter area may be heightened by the higher load of suspended matter there.

Dissolved oxygen and salinity levels do not vary greatly. The average salinity was 36.93 ppt, with a range of 0.28 ppt. The north shore salinity

was slightly higher and closer to outside levels than the south shore. Dissolved oxygen concentration was 5.8 to 6.5 mg/L, representing 90 to 102% of saturation. However, the majority of the lower values were measured in the area of the spoil-water runoff. This slight depression of oxygen is quite possibly caused by reducing chemicals which are released from the lower layers of grey or black sand when these are disturbed by the dredge.

The presence of reducing organic material in the dredge area is also indicated by generally lower pH values (8.2-8.3) than in the still unaffected northern shore and Pillsbury sound water which generally have a pH of 8.4.

The color of the water is still good, typical for a bay of this type, but was definitely milky white throughout the southern half of the bay. The distribution of the sand plume shifts rapidly with wind and currents, and as more material is suspended could eventually cover the entire bay. The vertical distribution of this suspended matter also varies and fluctuates, depending on water velocity,particle size and weight, and distance from the focus. This is indicated also by submarine light levels.

Submarine Light Penetration

Table 2 gives data recorded and calculated on the transparency of the water based on actual recordings of incident and submarine light, using a submarine photocell.

Direct reading of the available light at any depth in the water gives a true measure of the degree of occlusion caused by suspended or dissolved materials, an estimate of the extinction rate of light penetrating the water column, actual values for the amount of light lost by absorbtion, and values for the amount actually reaching the bottom and available to plants. Secchi depth measurements - the depth to which a black and white disk can be distinguished - were made to compliment the light readings.

At Stas. 14-18, where the heaviest concentration of suspended fines occured, up to 89% of the light was lost at one meter off the bottom. In the most turbid waters illumination was reduced at a rate of 8300-8600 foot-candles per meter. In these areas Secchi visibility was reduced to as little as 0.5 meters.

In contrast, in the unclouded areas of water the Secchi disk could be seen on the bottom, even to a depth of 13-14 meters and the average rate of light lost to the bottom was only 135-310 foot-candles per meter. Close examination of the data in Table 2 shows that the rate of light absorbtion at some stations is negligible in the first meter while at other stations the extinction rate measured at the bottom was higher, indicating a relatively greater turbidity in the portion of the water column below one meter. These vertical differences in the disposition of turbidity is reflected also in the scatter and wide range of suspended solids per litre of water samples (Table 1) and by visual inspection.

IV. ECOLOGY AND BIOLOGY

The dominant biotic feature of Great Cruz Bay is a typical algal-grass community (Syringodinium [Cymodocea]-*Thalassia*) which covers most of the undredged bottom. Scattered throughout this carpet are numerous worm hummocks and a few of the common calcareous algae, *Penicillus*, *Udotea*, *Halimeda*. Progressing toward the head of the bay the density of *Syringodium* and *Thalassia* decrease and the plants are shorter, while the density of worm holes increases and in patches many spiny black urchins, *Diadema*, occur. Quite a few conch were found grazing in the grass.

Within a narrow fringe below the rocky north and southwest shores there is a quite diverse gorgonian fauna. The substrate in these areas is bare sand and boulders, the dominant hard corals are elkborn (*Acropora*) and the fire coral (*Millepora*) although neither is abundant. In these limited rock/coral habitats there exists a characteristic, but small compliment of small colorful inshore fishes.

The most obvious life along the eastern shoreline are some well developed growths of filamentons red and green algae, including along the rocky northeast shore quite a bit of *Ulva* (sea lettuce). These particular types of algae are ordinarily associated with unusually enriched waters, but it is not known what favors their establishment and lush growth here. In the vicinity of the dredge and along the south shore below the area of rubble beach the turbidity precluded inspection. During the period of this investigation there were large numbers of fish fry in the eastern portion of the bay and sea birds were preying on them. Also in the northeastern part of the bay a large cloud of zooplankton, apparently a copepod, was discovered at about two meters down.

Summary

Great Cruz Bay support a typical, and well developed algal-grass pasture over the majority of its area. Only limited coral development occurs in narrow areas along the northwestern and southwestern shores. Present dredging operations are releasing large amounts of fine solids which experience has shown can remain in suspension over a year. This extreme turbidity has reduced, by as much as 89%, the amount of sunlight reaching the bottom in some areas. Visibility is reduced to as little as 0.5 meter. The water carries as much as 46 mg/l of solids. At the time of inspection only the southern half of the bay was affected. Increased loading of the water with sand fines will affect a greater portion of the bay and destroy the main biological features of the bay, its extensive pasture of sea grasses, by shutting out the light which these plants require. Heavier particles settling out on the bottom will smother the already limited area of reef-forming animals at the mouth of the bay.

IV. PERMITS DATA, GENERAL COMMENTS AND RECOMMENDATIONS

Historical

A Department of the Interior Submerged Lands Dredging Permit - No. 15 - was issued to Great Cruz Bay, Inc. on November 26, 1968, and a corresponding Corps of Engineers Permit - SAJSP Permits (68 - 806) was issued on December 6, 1968. The permits allow dredging of the entire bottom of Great Cruz Bay to within 300 feet of shorelines, to a depth of 15 feet below mean low water. Spoil to be taken is not to exceed 186,000 cubic yards, of which 29,000 cubic yards are to be

deposited along the south shore and 157,000 cubic yards in back of the east shore. The permittee is to be allowed to stock pile up to 50,000 cubic yards for construction aggregate or resale, with the rest to remain as fill in the spoil areas.

Work under the permit - blasting and draglining - was observed in the spring of 1969. In the summer of 1969 a small dredge started work off the eastern shoreline, pumping spoil back of the berm. A larger dredge, the TRIDENT moved into the bay and started work about 25th May 1970.

Current Water Quality Conditions

The Corps of Engineers permit requires compliance with federal and local regulations, conditions or instructions regarding water pollution. Work under this permit is being accomplished without consideration of effects on water quality, or destruction of marine life forms. No attempt is made to minimize the quantity of fine material in suspension in the water, and as a result the attached biota outside of the dredged area will almost all be killed. These destructions will not be confined to the areas inside the bay itself, but will include smothering of the outside reef corals and algae. We recommend:

(1) that the permittee be required to pond and contain the dredge discharge so that a much cleaner effluent is returned to the bay.

(2) that the air release devices in the discharge piping be controlled to minimize discharge of silt/water into the bay.

Relative to the siltation occurring in Great Cruz Bay, we feel that the operation is being conducted in a manner to exclude the fines from the fill areas; that is, to return this material to the bay water.

Comment on Permit

We strongly hold the opinion that the permit itself is an indefensible destruction of a natural resource, and operates against the best interest of the territory. We can see no possibility that Great Cruz Bay will be a more desirable area as a result of the dredging operation, which will completely remove the upper benthic layer. Water quality in the bay will be degraded for years to come; and repopulation of the area by the interesting and valuable sublittoral flora and sessile fauna will take even longer. Conservative development of the area could have produced a prime recreational/habitat asset, because of the natural geographic features which exclude most of the high energy sea forces and promoted growth of varied and healthy benthic communities.

TABLE I

Great Cruz Bay, St. John

Water Quality Data, 26 May, 1970

ation	Temp. (°C)	Salinity (ppt)	pH	Color (2) (Forel-Ule)	Dissolved Oxygen (mg/L)	Suspended solids (mg/L)	Secchi (1) Depth (meters)
1	27.5	36.97	8.4	V	5.8	5	b7.25
3	27.5	37.01	8.4	V	6.4	32	b4.25
4	27.9	--	8.4	VI	6.5	12	b3.25
5	27.5	--	8.4	VI	6.4	10	b3.0
6	28.0	37.10	8.4	VIII	6.0	27	2.25
7	28.1	36.82	8.4	VIII	6.0	36	2.25
8	27.8	--	8.4	VI	6.4	14	3.0
9	27.9	--	8.5	VII	6.4	3	b2.25
10	27.9	36.96	8.4	VI	6.4	46	b3.25
11	27.5	--	8.2	V	6.4	37	2.75
12	27.5	--	8.2	V	6.4	35	7.5
13	27.8	--	8.2	V-wh	6.4	6	4.0
14	28.0	--	8.3	VI-wh	6.4	40	1.75
15	28.1	36.82	8.3	VI-wh	6.4	15	1.0
16	28.3	--	8.2	VI-wh	5.9	37	0.5
17	28.3	--	8.3	VI-wh	5.9	32	0.5
18	28.4	36.82	8.2	V-wh	5.9	71	0.5
19	27.6	36.82	8.2	IV	6.4	27	8.0
20	27.5	36.96	--	IV	6.4	19	b9.0
22	27.5	36.98	--	IV	6.1	34	b13.25
23	27.5	36.96	--	IV	6.1	33	b14.0
erage (3)	27.9	36.93	8.3	VI	6.2	27	2.9

(1) "b" indicates visibility to the bottom
(2) "wh" pronounced white color due to suspended sand fines
(3) excluding stations 19-23

TABLE II

Incidents and Submarine Light Data

Great Cruz Bay, St. John

26 May, 1970

ation	Surface Light (ft.candles)	PCT Reduction at 1 meter	Extinction rate in first meter (Ft-Cand./M.)	PCT Reduction at 1 meter off bottom	Extinction rate @ 1 meter off bottom (Ft-Cand./M)	Avg.Extinc. rate (1) Ft-Cand./M)	Water Depth (Meters
1	9,900	14.2	1400	68.6	1,088	1244	7.25
3	9,100	6.6	600	32.4	908	754	4.25
4	8,750	20.3	1775	31.7	1,233	1504	3.25
5	9,100	6.6	600	15.9	725	662	3.00
6	8,900	24.2	2150	42.9	2,550	2350	2.50
7	9,100	25.5	2325	68.7	1,926	2125	4.25
8	7,850	27.1	2125	50.6	1,766	1945	3.25
9	9,675	--	--	nil	--	nil	2.25
10	8,966	nil	nil	nil	nil	nil	3.25
11	9,500	nil	nil	69.4	1,143	571	6.25
12	9,500	nil	nil	74.9	1,091	545	7.50
13	9,075	nil	nil	75.5	1,371	685	6.00
14	8,900	59.0	5250	73.7	2,385	3817	3.75
15	7,200	--	--	74.7	5,380	5380	2.25
16	8,400	--	--	89.4	7,510	7510	2.25
17	9,900	--	--	83.7	8,294	8294	2.50
18	9,600	--	--	89.2	8,567	8564	2.00
19	7,900	22.1	1750	72.1	600	1175	10.50
20	8,000	nil	nil	61.8	619	309	9.00
22	6,000	2.5	150	61.4	300	225	13.25
23	5,800	nil	nil	60.0	268	134	14.00

(1) Average of extinction rates calculated at 1 meter down and 1 meter off the bottom.

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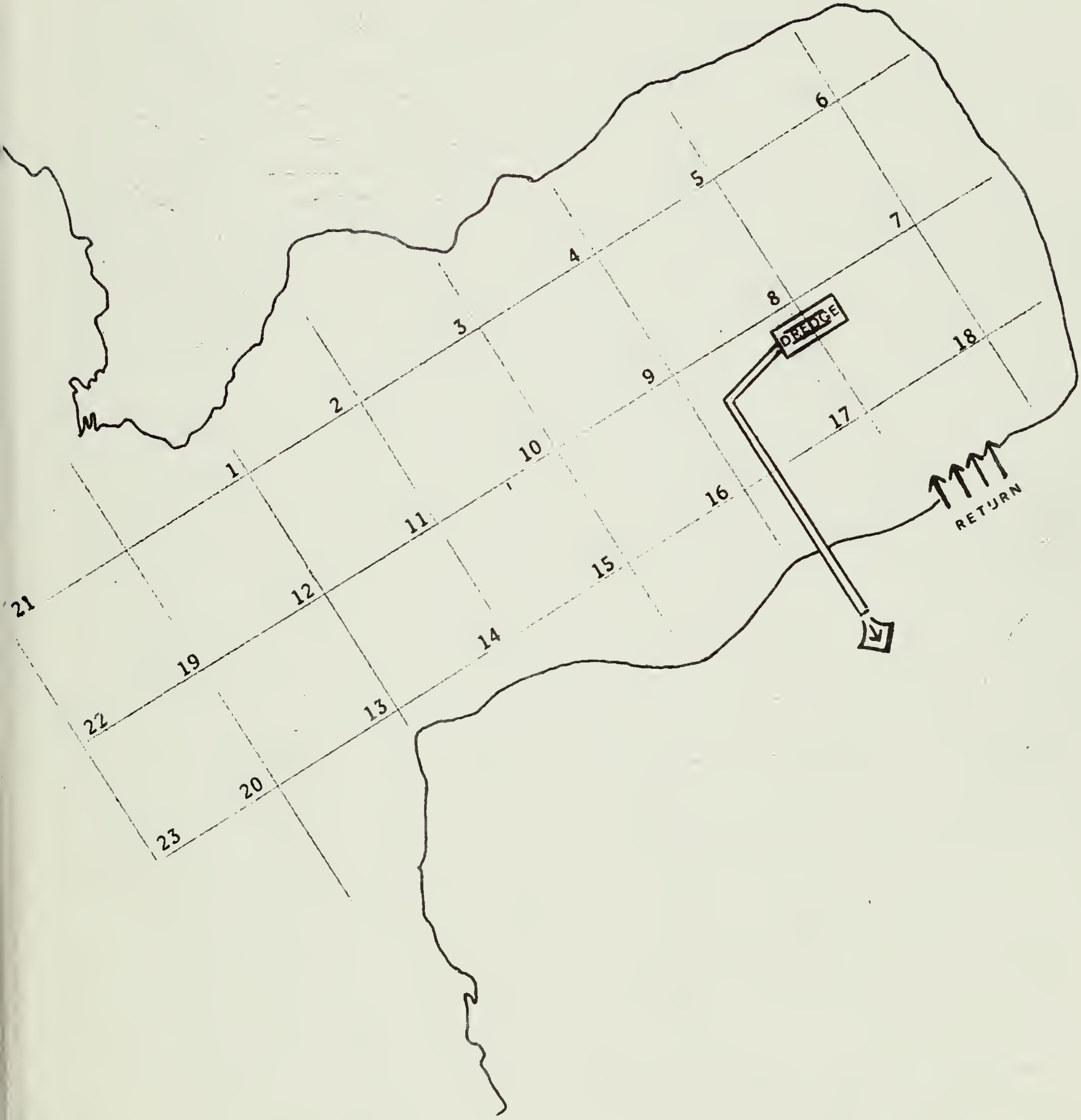

Fig. 1
Great Cruz Bay, St. John
Station numbers
and location of
dredge on 26 May, 1970

CONTANT

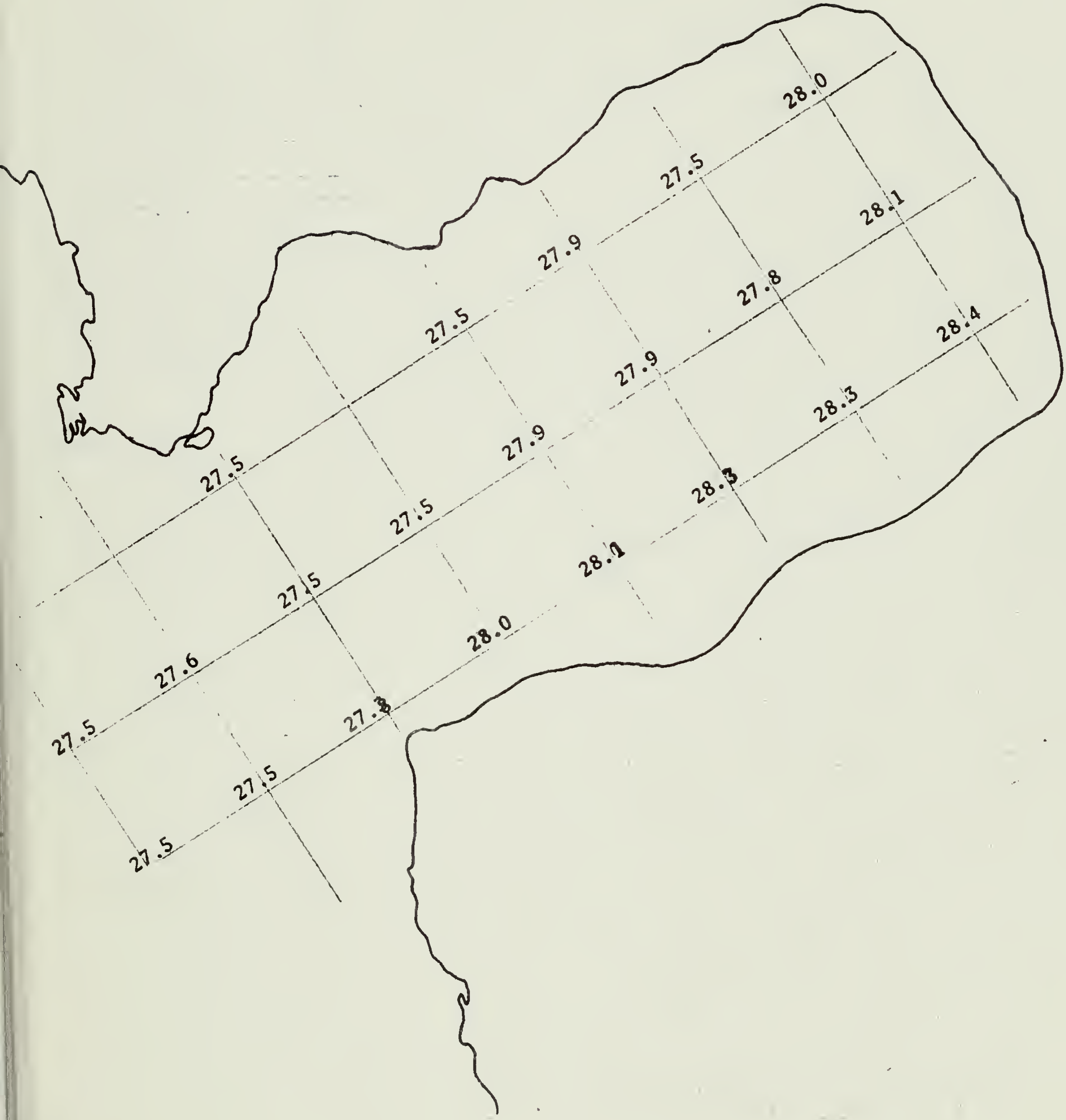

Fig. 2
Great Cruz Bay, St. John
Water temperature
degrees Centigrade

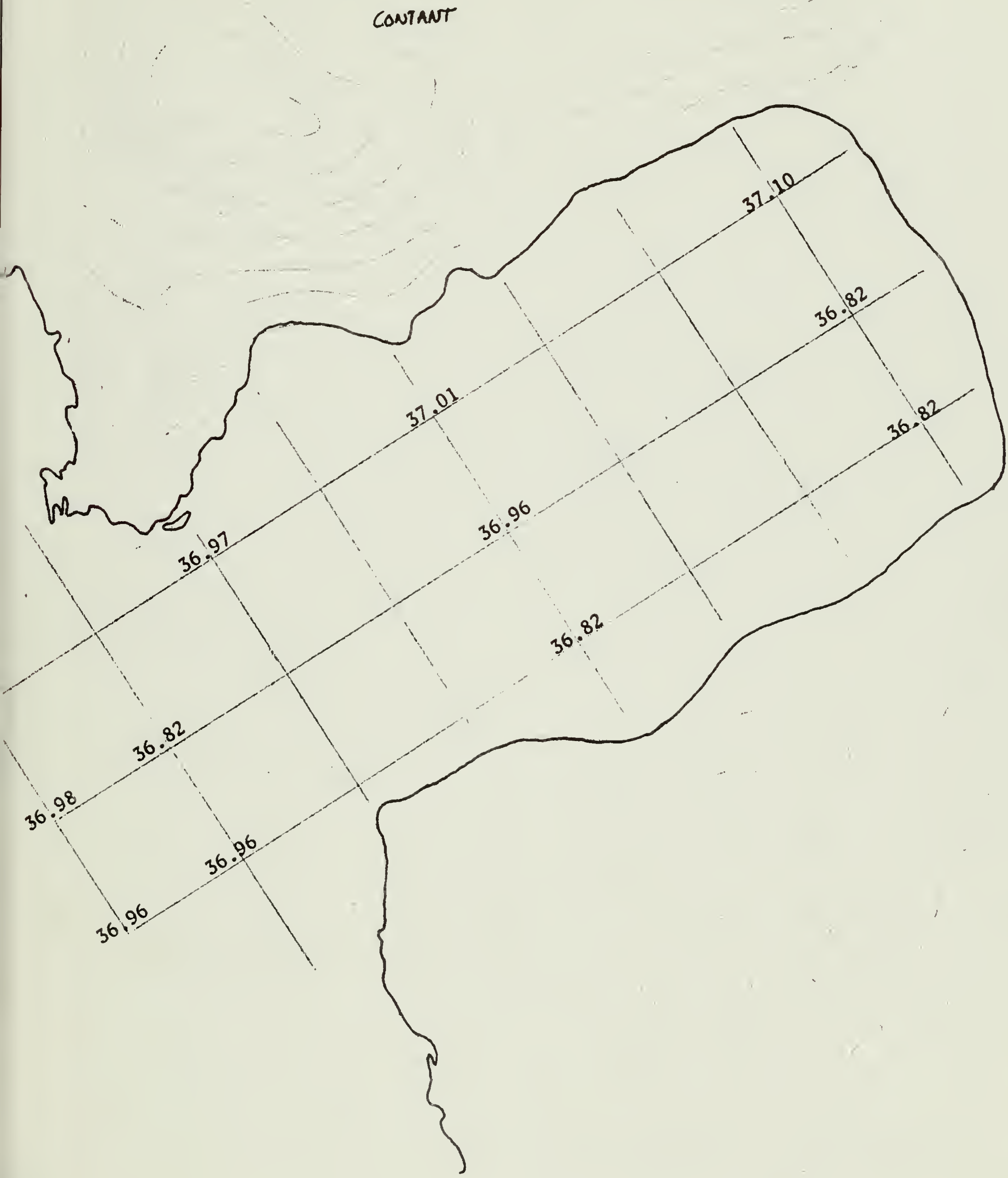

Fig. 3
Great Cruz Bay, St. John
Salinity, ppt.

CONTANT

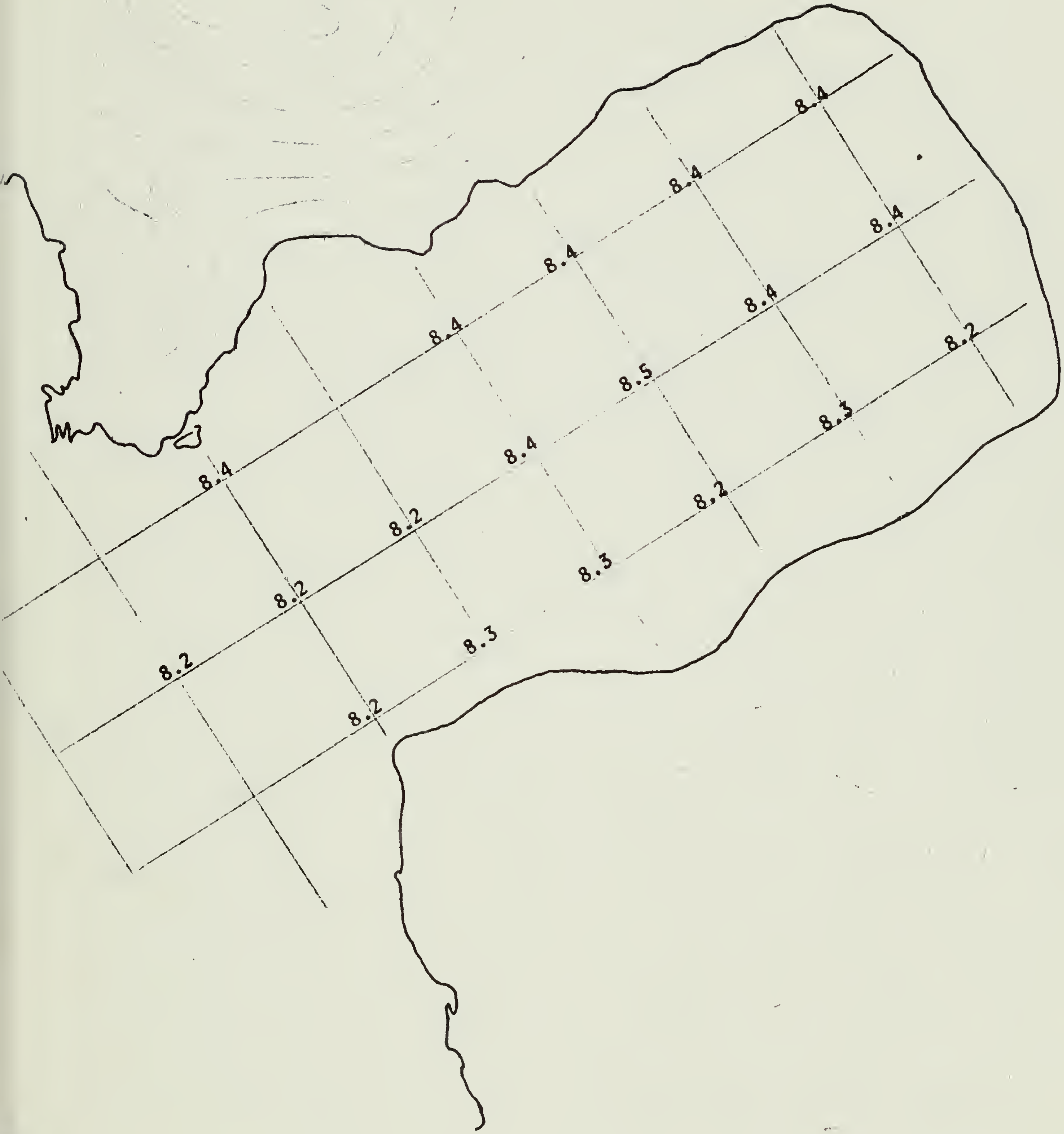

Fig. 4
Great Cruz Bay, St. John
pH

CONTANT

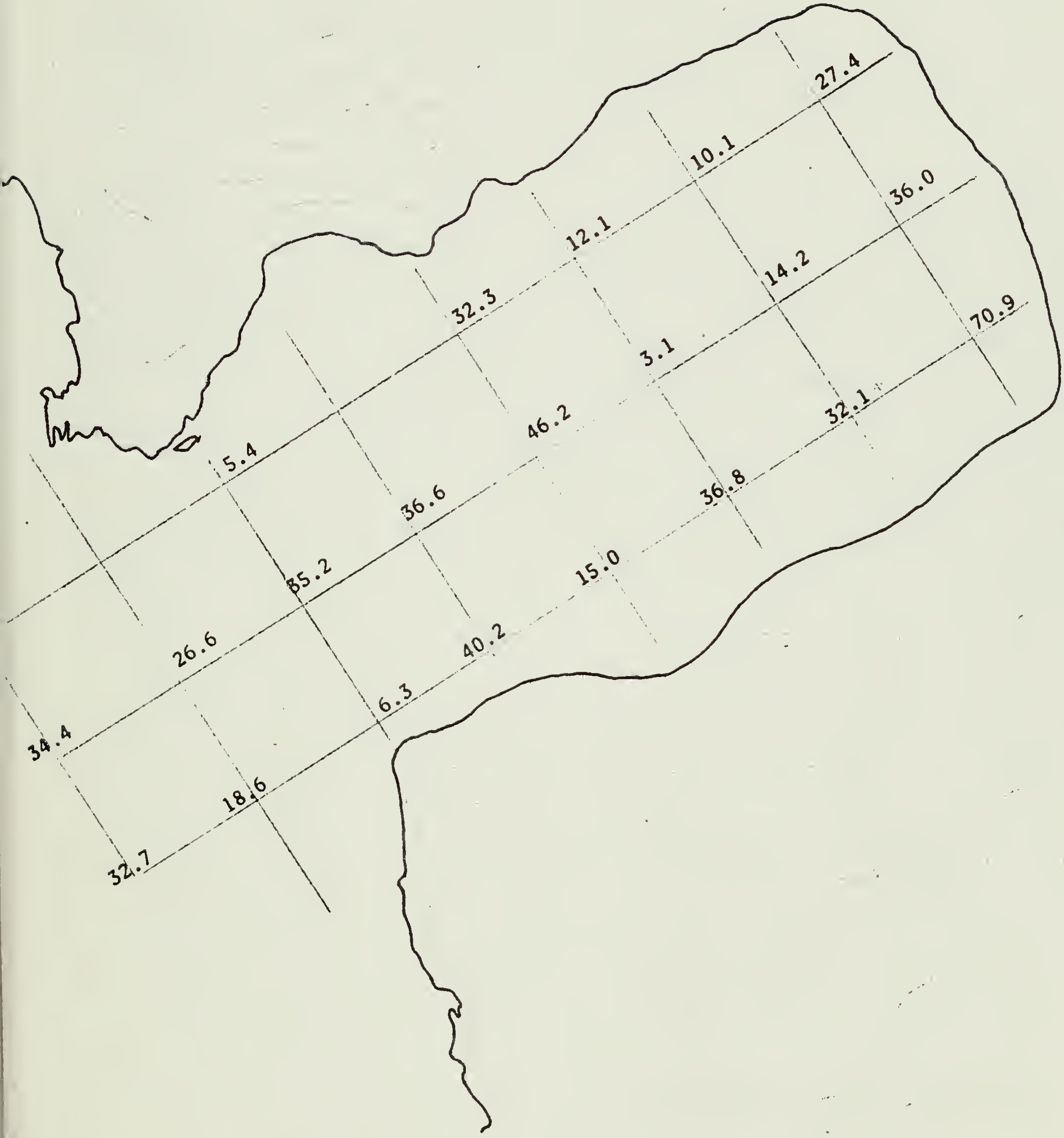

Fig. 5
Great Cruz Bay, St. John
Suspended Solids
mg/L

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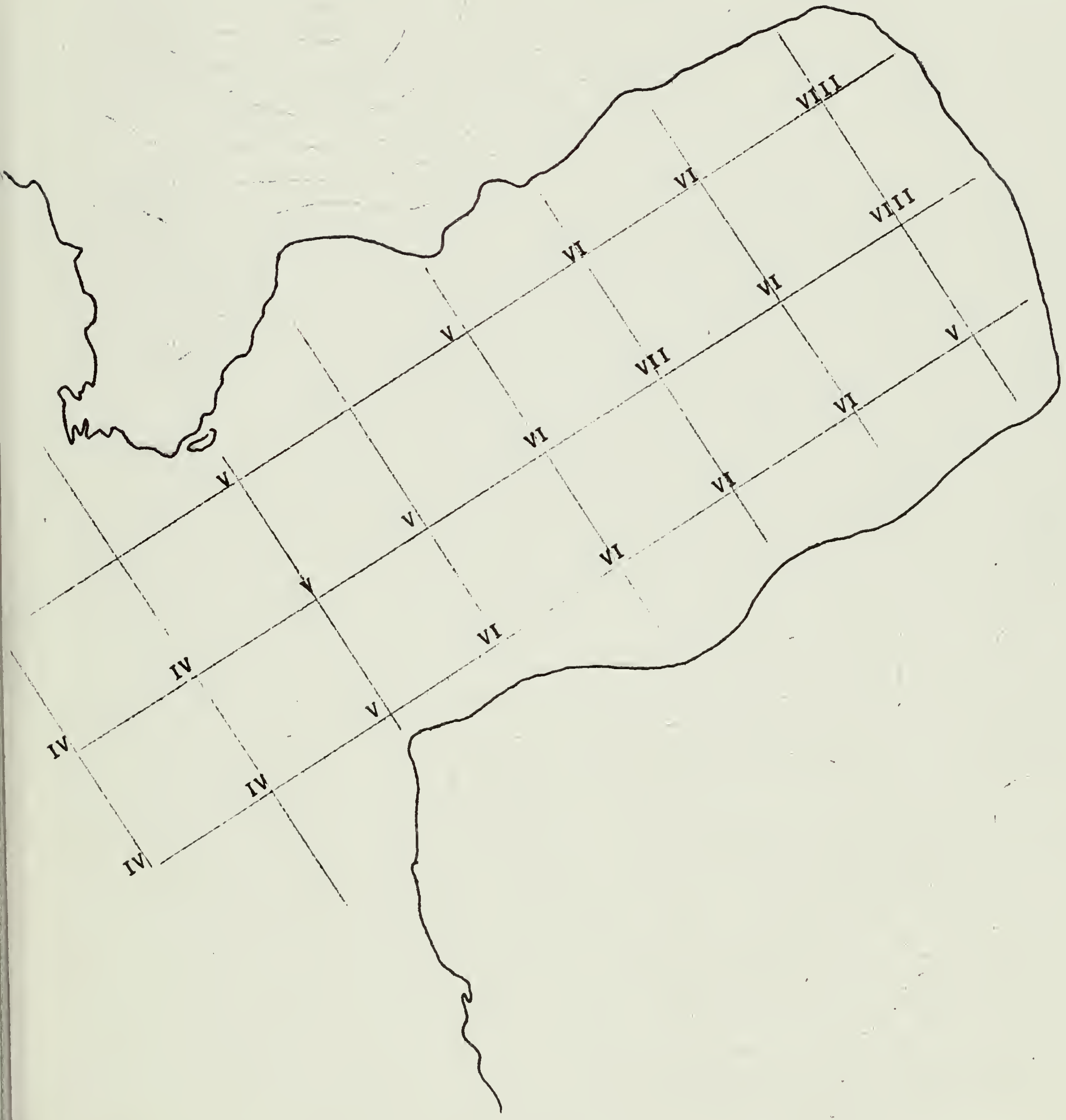

Fig. 6
Great Cruz Bay, St. John
Forel-Ule Color

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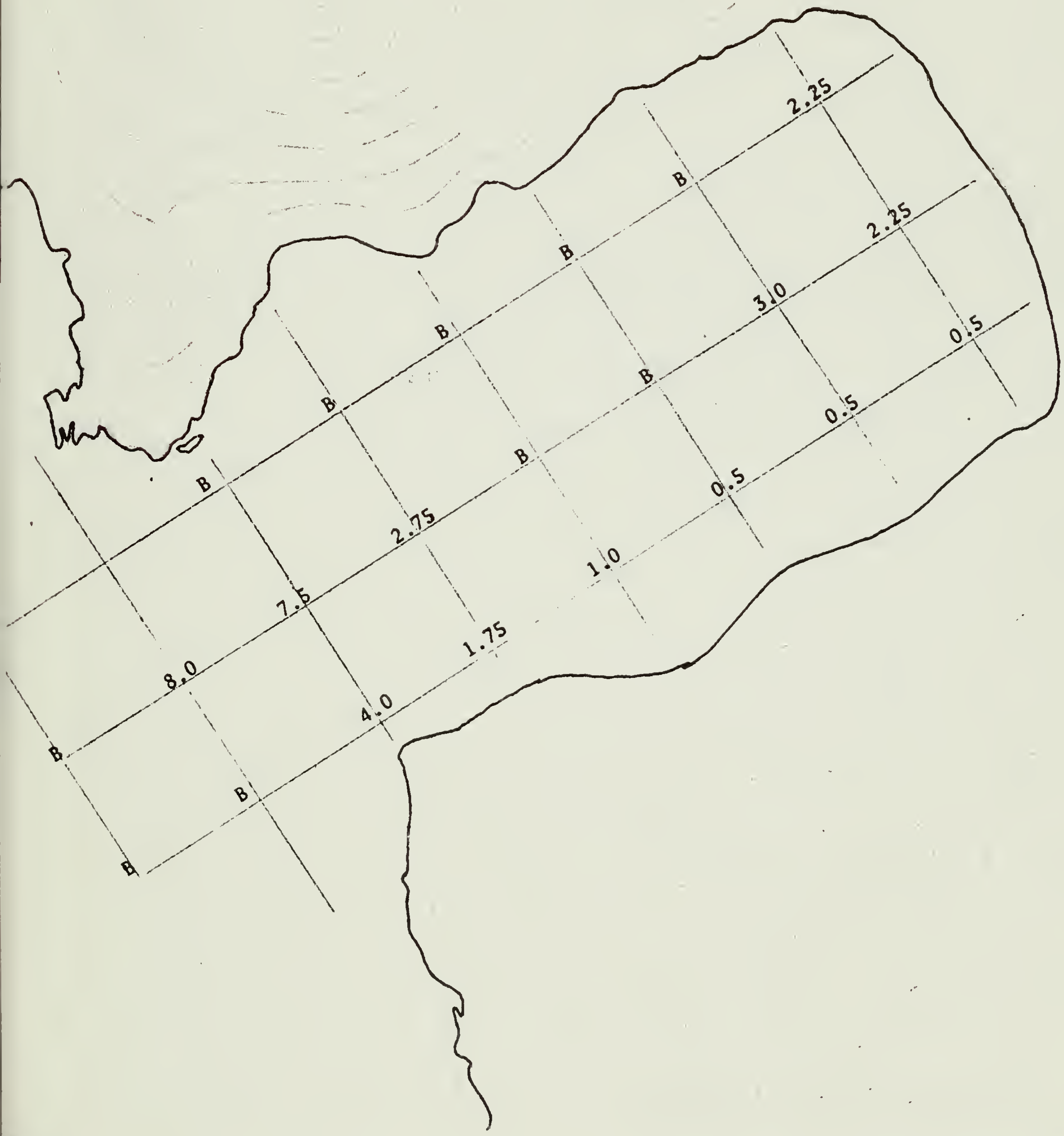

ig. 7
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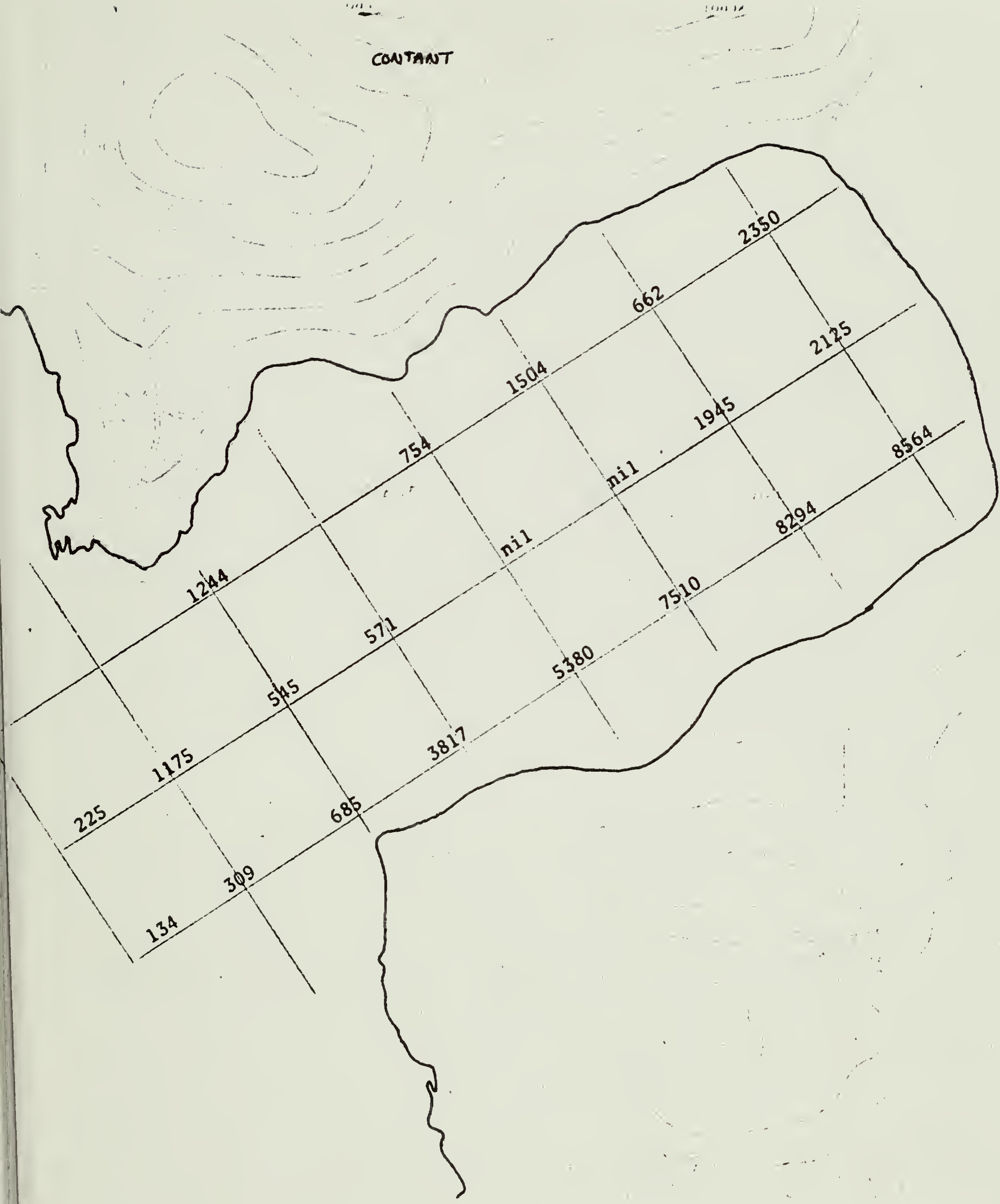
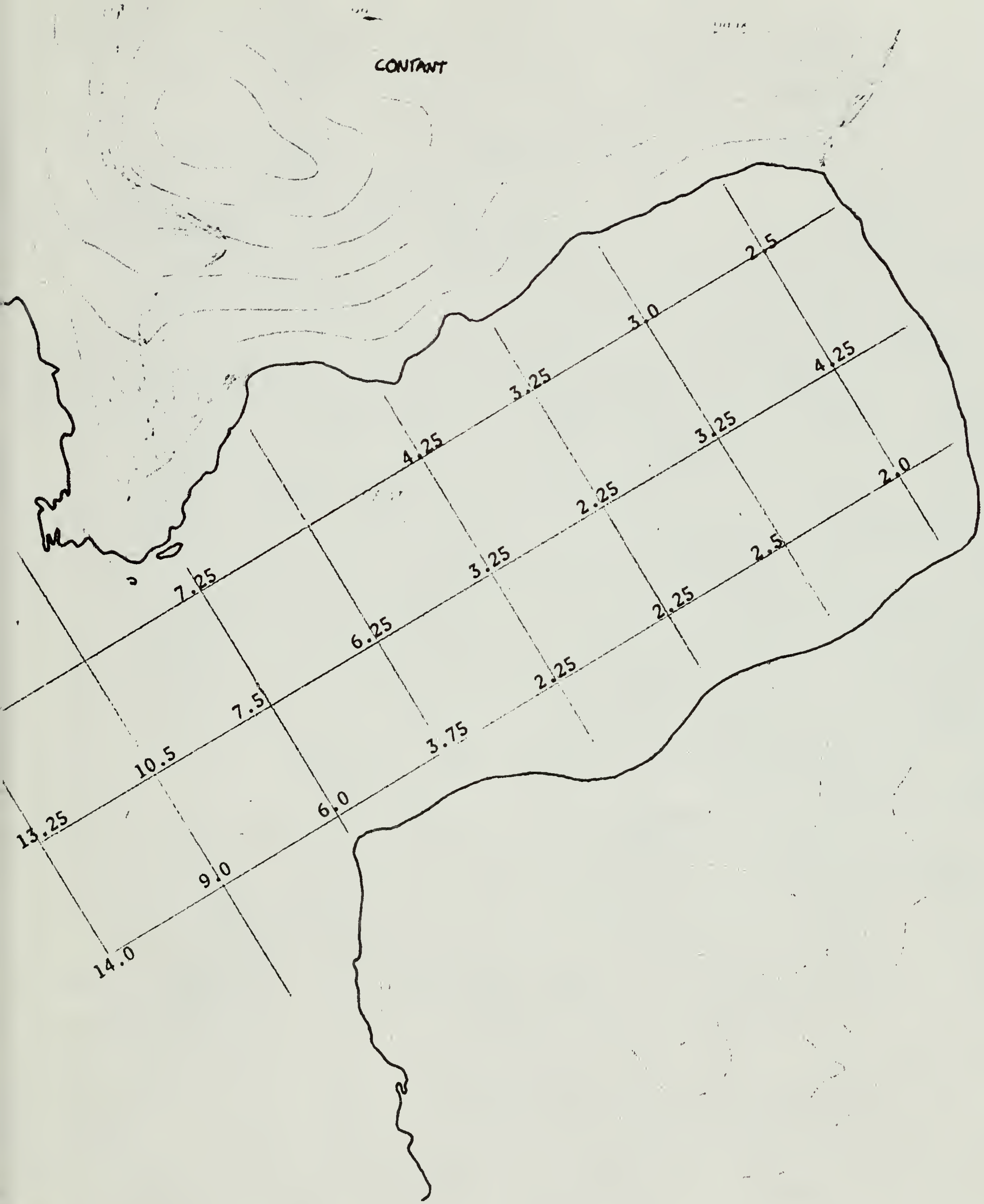
ecchi depth (meters)
=bottom



ig. 8
reat Cruz Bay, St. John
xtinction Rate
t-candles/meter
o the bottom



9
Cruz Bay, St. John
Depth
rs)